**PATENT COOPERATION TREATY**

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

### (PCT Article 36 and Rule 70)

| Applicant's or agent's file reference<br>HL81304/021/DCO | **FOR FURTHER ACTION** | See Notification of Transmittal of International<br>Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| International application No.<br>PCT/EP 03/08902 | International filing date *(day/month/year)*<br>11.08.2003 | Priority date *(day/month/year)*<br>02.09.2002 |

International Patent Classification (IPC) or both national classification and IPC
G10H7/02

Applicant
TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 13 sheets, including this cover sheet.

    ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

    These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

    I    ☒  Basis of the opinion

    II   ☐  Priority

    III  ☐  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

    IV   ☒  Lack of unity of invention

    V    ☒  Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

    VI   ☐  Certain documents cited

    VII  ☐  Certain defects in the international application

    VIII ☐  Certain observations on the international application

| Date of submission of the demand<br><br>11.03.2004 | Date of completion of this report<br><br>26.10.2004 |
|---|---|
| Name and mailing address of the international<br>preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized Officer<br><br>Feron, M<br><br>Telephone No. +49 89 2399-2478 |

# INTERNATIONAL PRELIMINARY
# EXAMINATION REPORT

International application No.    PCT/EP 03/08902

## I.  Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)):*

**Description, Pages**

1-14                              as originally filed

**Claims, Numbers**

1-14                              received on 04.10.2004 with letter of 29.09.2004

**Drawings, Sheets**

4/5, 5/5                          as originally filed
1/5-3/5                           received on 04.10.2004 with letter of 29.09.2004

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language:     , which is:

   ☐   the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐   the language of publication of the international application (under Rule 48.3(b)).

   ☐   the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐   contained in the international application in written form.

   ☐   filed together with the international application in computer readable form.

   ☐   furnished subsequently to this Authority in written form.

   ☐   furnished subsequently to this Authority in computer readable form.

   ☐   The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐   The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐   the description,      pages:

   ☐   the claims,           Nos.:

   ☐   the drawings,         sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

   **see separate sheet**

## IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

   ☐ restricted the claims.

   ☐ paid additional fees.

   ☐ paid additional fees under protest.

   ☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

   **see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☒ all parts.

   ☐ the parts relating to claims Nos. .

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

   | | | | |
   |---|---|---|---|
   | Novelty (N) | Yes: | Claims | 6,7 |
   | | No: | Claims | 1-5,8-14 |
   | Inventive step (IS) | Yes: | Claims | |
   | | No: | Claims | 1-14 |
   | Industrial applicability (IA) | Yes: | Claims | 1-14 |
   | | No: | Claims | |

2. Citations and explanations

**see separate sheet**

## 1. Amended documents

The replacement set of claims dated 29.10.2004 only includes 14 claims, but the accompanying letter of 29.10.2004 announces that the replacement set includes 16 claims.

The letter is assumed to be in error, because new claim 14 looks like previous claim 16: accordingly it is assumed that originally filed claims 15 and 16 were intended to be deleted.

## 2.Interpretation and marginal lack of support of the object of claims 7 and 8.

a. The amendment of "coefficients of a sinc function" in former claim 8 to "coefficients of a truncated sinc function" in present claim 7 (in order to overcome a violation of Art.5 PCT because a non-truncated sinc function is not implementable and non-causal) is alleged by the applicant to be based on page 3 line 25-28, but is presently not considered to meet Art. 34(2)b PCT for the following reasons.

     a. This amendment is not properly supported by this passage, which describes a disadvantage of prior art embodiments, which has to be overcome, and not at all a description of the alleged invention itself.

     b. It is also not supported by the entire description, which has not been amended accordingly and still appears to suggest (compare page 3 with page 9) that the use of "coefficients of a sinc function" is somehow more optimum than the use of a "truncated sinx/x algorithm", which is said in page 3 to be "sub-optimum".

         (i)- If the applicant did not mean the same thing in pages 3 and 9, then it is not known what "coefficients of a sinc function" are supposed to mean, and there clearly can be no support by "truncated sinx/x algorithm", i.e. Art.6 PCT is not met. Furthermore the requirements of Art.5 PCT and Rule 5.1(a)(v) PCT are not met because it is not known exactly what is meant by "coefficients of a sinc function"

         (ii)- On the other hand, if the applicant did mean the same thing in pages 3 and 9, i.e. "coefficients of a sinc function" of page 9 are supposed to somehow result from "truncated sinx/x algorithm" of page 3, then the applicant did not explain what makes its implementation better than this "sub-optimum interpolation algorithm" (what changes are made to it so that the algorithm becomes less "sub-optimum" and so that the problem is solved), i.e. the requirements of Art.5 PCT and Rule 5.1(a)(v) PCT are not met.

         (iii) There clearly are no possibilities other than the above two, so that appropriate support by page 3 is clearly impossible.

c. Another difficulty is the lack of clarity of the expression "coefficients of a sinc function", which has no mathematical meaning, because clearly a sinc function (sin x)/x has no coefficients per se; the above discussion about the contrast between pages 3 and 9 also proves that it can have no clear special meaning in the context of the application. So what do these "coefficients" mean and how are they derived? The application appears to be silent about that, but if that is what makes the difference between the "sub-optimum interpolation algorithm" of the prior art and the present invention, then this difference, and hence the exact meaning of "coefficients" in this expression should have been disclosed.

(i)- The application mentions in page 3: "a sub-optimum interpolation algorithm such as a truncated (sin x)/x algorithm" [parenthesis error corrected]"
If this is supposed to imply that the "coefficients" are supposed to be the result of an "interpolation" then it is not clear what such an interpolation might be, because a sinc function is mathematically continuous; it can be sampled for any value of x and any interpolation is therefore useless and counterproductive, besides not making any mathematical sense.

(ii)- It is suspected that "samples" might have been meant instead of "coefficients" because "samples" are the only values extracted from a sinc function which might make sense in a digital signal processor.

d. The last response implies that the applicant means exactly the same thing in page 3 and 9: if that is so, then the description still presents both the alleged invention and the prior art in a misleading way.

However, as the skilled person tries to implement the somewhat obscure feature "coefficients of a sinc function" (in fact, "samples of a sinc function" or "coefficients from a sinc function" or, see page 9 line 7, "values that are representative of a sinc function" appear to be meant, and not some sort of -unclear because implicitly multiplicative- coefficients of a sinc function), he/she has no choice but to truncate the infinite extent of the sinc function in both positive and negative(!) time, thus negating the difference implied then and now in the description as originally filed between page 3 and page 9.

Since the word "sample" does not appear in the description in connection with a sinc function, the only correct and explicit basis for amendment of claims 6 and 7 in the application to overcome the lack of clarity of "coefficient" is on  page 9 line 7, "values that are representative of a sinc function"; this would implicitly support claiming "values that are representative of a truncated sinc function" (not because of page 3,

as alleged by the applicant, but because the skilled person has no other option than to truncate the otherwise infinite extent of the sinc function to fit it in the inherent finiteness of the digital world) This change in the claims would appear to be implicitly supported, provided the description on page 9 line 7 is also modified accordingly, or the term suboptimum is deleted from page 3, to avoid implying a difference with the prior art's allegedly suboptimum methods.

Until this is done, this amendment has to be regarded as not meeting Art.34(2)b PCT, Art.5 PCT, Art. 6 PCT and Rule 5.1(a)(v) PCT

     e. The filter of claim 6 and truncated sinc function of present claim 7 have the effect that high notes or harmonics above a given frequency simply will not be reproduced because the operations of page 8 lines 28-35 amount to low-pass filtering by time-domain convolution.

     (i)- At present the claims do not claim any specific cutoff frequency or sinc function period (the statement in page 9 line 8 is actually improper because a sinc function is not exactly periodic, but the skilled person understands what the applicant means).
A priori if nothing else were precised about the desired cut-off frequency this might appear similar to the note-dropping principle of D2=US2001/045155 since certain sounds would appear to be cut off by low-pass filtering at an arbitrary frequency.

     (ii)- In fact careful inspection of the choice of the specific preferred sinc function "period" on page 9 suggests that the main and most important technical contribution of the present application appears hidden in this choice (it appears to be unfortunate that this so-called "period" was not claimed) because the main motivation for its implementation appears to be more to provide a suitable digital reconstruction filter compatible with artifact-free sound at very low reproduction sample rates than to simply drop certain notes (this would otherwise be a rather computationally wasteful way of dropping notes!).

     f. It could thus be argued that the preferred embodiment of page 9 line 8 simply implements digitally the reconstruction filter which is absolutely necessary for any proper conversion of digitally coded sound to analog waveforms, and which was typically implemented in analog form after the DAC in prior implementations.
In the preferred embodiment of page 9 lines 6-9, since the "period" of the sampling function is twice the sample period, this specific period choice, if it were actually claimed and if it corresponded to a filter implementable in real life, could a posteriori be considered obvious because it would be a priori perceived to merely implement an ideal

digital reconstruction filter, which classically cuts off all output at half the sampling frequency (Nyquist frequency).

Nevertheless if that filter had been claimed in sufficient detail, a non-negligible technical contribution (in any case apparently more significant than that of assigning a sampling rates which are determined only on the basis of the number of active voices) could have been seen in the digital implementation of such a filter for the reproduction of active voices having different sampling rates because of the inherently greater flexibility of such a filter as regards the necessity of cutoff frequency changes due to the sampling rate changes.

If a suitable and physically implementable filter had been properly disclosed by its filter properties or preferably by the corresponding time domain truncated sinc function samples, then that feature would have been considered to be novel and inventive over all documents of the prior art because it would have permitted the reproduction of sounds at very low sample rates without audible artifacts and would appear to permit a simple, artifact-free combination of digital waveforms at vastly different sampling rates, thus allowing polyphony reproduction with an absolute minimum number of samples.

Note that Nyquist filters at about half the sampling frequency are considered obligatory for proper analog reconstruction of sampled signals (see any basic digital signal processing textbook), but since perfect filters are not realizable the idea of suppressing high notes is already known from D2 (but the difference with D2 is that D2 reaches the same effect in a computationally more efficient manner: in D2 those notes are simply not calculated whereas in the present application, the additional calculations of page 8 line 31-35, assuming a sinc function were practically implementable, cause the samples expressing notes above that frequency to become zero).

## 2. The remaining claims are anticipated by the prior art
The documents of the search report are:
- D1:  EP-A-0 750 290 (YAMAHA CORP) 27 December 1996 (1996-12-27)
- D2:  US 2001/045155 A1 (BOUDET DANIEL ET AL) 29 November 2001 (2001-11-29)
- D3:  EP-A-0 752 697 (YAMAHA CORP) 8 January 1997 (1997-01-08)
- D4:  GB-A-2 040 537 (MICROSKILL LTD) 28 August 1980 (1980-08-28)
- D5:  US-A-5 939 655 (SATO HIROYUKI) 17 August 1999 (1999-08-17)

D1-D5 reflect the fact that polyphonic synthesisers have long had to use algorithms to

cope with computational complexity limitations of synthesiser processors: the processors of yesteryear were much less powerful than the processors in today's mobile telephones.
Accordingly the problem is well-known, and its known solutions as taught in each of D1-D4 are substantially the same as the claimed subject-matter.

Please note that the present independent claims give to the expression **"interpolation degree"** a **special meaning** (EPC Guidelines C-III 4.2) which is much broader than the meaning which it normally has in the art, as it may have nothing to do with an interpolation in the usual sense, since it is defined as a mere **"number of samples selected"**. This broad meaning implies that even prior art not using interpolation at all anticipates this feature as soon as it selects samples.

Each of D1-D4 independently anticipates all claims except claims 6 and 7 because each of those documents discloses methods for decreasing the computational load of processors used in MIDI synthesisers by skipping samples, whereby the number of samples used for each active voice depends on the overall computational complexity, and therefore depends on the number of active channels or voices, since the computational complexity is affected by this number.
The fact that the claims have been amended so as to no longer mention computational complexity does not make these documents D1-D4 any less relevant, nor the claims any more inventive, because the claims are interpreted in the light of the description, which reveals that like in D1-D4, the problem to be solved is to reliably limit computational complexity.

a. D1 describes a multimedia computer (see fig.1) programmed to function as a polyphonic MIDI synthesiser. The memories storing a plurality of stored samples at different sampling resolutions are shown in Fig.5A-5E.

Claims 1-3, 7 and 12,13 lack novelty over D1, and all claims lack an inventive step over D1, see abstract, Fig.17 and page 11 line 40 -page 12 line 19 of D1, in particular the description of the channel processing step S340 which determines a "calculating order" (determination of number and ranking of active channels only) for computing a computational complexity at step S350 and comparison at step S360 with a maximum level of complexity.
If this maximum level is exceeded, then (see p.12 lines 2-6) the "waveform sample forming resolution CC of each channel... is lowered by 1, so as to reduce the number of samples to be actually formed".

Therefore in the synthesiser of D1, like in the present independent claims, the number of samples used for each active voice depends in particular upon the number of active voices, which is part of the data used to compute the calculating order which serves to evaluate computational complexity.

The present set of claims do not require the number of samples to depend uniquely and exclusively from the number of active channels, resp. uniquely and exclusively from the number of the active voices. Therein lies the difference of opinion between the IPEA and the applicant about the significance of the cited prior art.

On the contrary the present description foresees that other method steps may be included (see page 5 lines 10-15) and foresees other alternatives (see page 10 lines 22-26) such as the maximum complexity criterion (in other words exactly the same method as used in the MIDI synthesizer taught by D1) as being within the scope of the claims. This is clear evidence that the present claims 1,8,12 necessarily lack novelty over D1.

As a result, even though unlike in the preferred embodiment there is no clear one to one correspondence between number of active channel and number of samples, the feature "depends upon" is considered to be anticipated by D1; the other features of claims 2-4,5, 13,14 are implicitly known from D1, resp. are common sense, because more active channels implicitly amount to a higher complexity, to be compensated by using a smaller number of samples. This assessment would have been different if the claims had claimed "depends only upon": only then would the applicant's arguments about the alleged non-relevance of D1-D4 convincing

  b. Claims 1-5,8-10 and 12-14 lack novelty over D2, and all claims lack an inventive step over D2 because D2 teaches a mobile phone 110 using a polyphonic MIDI synthesiser operating on simplified, compressed MIDI data, wherein instances of polyphony (implicitly, a number of active channels greater than 1) are detected (see abstract and paragraphs 0053-0056), a computational complexity is derived , and if superior to the computational complexity limitation of the mobile phone's synthesiser, then selected whole notes are dropped so as to reduce computational complexity below the mobile phone's limit, exactly as presently claimed in present claims 1-5,8-10 and 12-14, and particularly in claim 10.
Indeed, since whole notes are dropped, the samples which represent them are not present, and therefore the number of samples selected for the corresponding voice (i.e the "interpolation degree" as this expression is defined in the present claims) is less.

Therefore also in this case the number of samples actually used for each active voice also depends on the number of active voices, in addition to other criteria, and for this reason Claims 1-5,8-10 and 12-14 are considered to lack novelty over D2.

Claim 11 lacks an inventive step over D2 because a pager is similar to a mobile phone and does not substantially nor technically differ from it as far as the necessary ringing tone is concerned.

   c. D3 anticipates the same claims because it teaches, see figs 5 and 6 as well as col.3 line 35 and col.9 line 50, to calculate tone waveform samples "with different precisions depending on the calculation amount involved in the calculation process"; whereby "the lowering of the calculating precision may be effected by lengthening the sampling clock period..." . This therefore affects the number of samples selected, and hence what the applicant defines as being "interpolation degree" in the present independent claims.

   d. D4 describes succintly in the last paragraph of its page 4, particularly line 47, the compromises which may have to be made in a polyphonic sound generator (described in more detail in fig.1 and page 2 lines 34-56 as having a wavetable, line 35, and a variable sampling rate and sample skipping rate, lines 37-48) in dependence "upon the number of simultaneously sounded notes at any one time", and thus is also understood to anticipate the same claims.

**3. Suggestion to comply with the novelty and inventive step requirements of the PCT:**
   a. Although D4 come very close to suggesting a solution based **only** on the number of active voices in page 4 line 47, it fails to detail that solution as much as present claim 1, and the other documents, by contrast, all teach using additional parameters in addition to the number of active voices to derive computational complexity for suitable rate setting.
   b. Accordingly, it appears that none of the prior art documents suggests assigning a voice sampling rate which has the same value and is varied in the same way for all voices and is determined **only** on the basis of the number of active voices, and of nothing else, as suggested in the tables of present figures 3 and 4 (The word "only" here would make all the difference with the prior art.).
   c. In such an approach in which the word "only" would be claimed in the independent claims there is thus no computational overhead to evaluate computational complexity, or if any (it's just a table lookup, without any arithmetic operation), in any

case much less than in the prior art.

 d. If this feature were added based on figures 3 and 4, or a reference to the tables of fig.3 and 4 were made, D4 would become the closest prior art: the cited passage of D4 page 4 line 47 would almost anticipate such an amended claim but cannot be interpreted to suggest a combination of that specific feature with the other claimable specific feature of assigning a voice sampling rate which has the same value and is varied in the same way for all voices.

This other claimable specific feature also reduces the computational complexity calculation overhead found in other prior art and thus constructively participates and contributes in solving the same problem in the same way: keep the interpolation degree determination as simple as possible  so as to minimise not only the calculations for computing the sound samples, but also so as to minimise the computations  to determine the computational complexity of the music to be played... even if the price to be paid for this approach is that the computational resources of the processor are less well used, i.e. the music may be simplified more than needed.

 e. This is an advantage of this simplistic approach, and if the claims had been thus amended, this advantage could well have been sufficient for a positive report to have been written.

## 4. Irrelevant and scope-obscuring subject matter in the description

The application is contrary to Art.6 PCT (lack of clarity of the claims), Rule 5.1(a)(iii) (a passage of the description does not relate to the claimed invention) and Rule 9.1(vi)(irrelevant and unnecessary subject-matter in the description in that it does not relate to the claimed invention due to the omission of an essential feature of the independent claims) because of a discrepancy between description and claims: the description paragraph of page 10 lines 22-26 relates to an unclaimed alternative because of the word "alternatively" at the beginning of that paragraph, which suggests that the last feature of independent claims 1 and 12 actually might be non-essential for the alleged invention.

Accordingly this word "alternatively" obscures the scope of the independent claims, and particularly of their most important and most essential feature, the dependence on the number of active voices.

Moreover this statement  is interpretable to broaden the scope of the independent claims to any synthesiser making use of any kind of maximum complexity limit to set the interpolation degree (i.e. the independent claims are implicitly no longer restricted to criteria which depend on the number of active voices), and therefore this small word

anihilates any remaining difference with the prior art documents D1-D5, which all disclose prior art synthesisers with some kind of computational complexity limit steering the number of samples to be used in some way. Also for this reason the applicant's arguments about the alleged irrelevance of D1-D5 are considered unconvincing.

This description paragraph thus not only causes the independent claims to be contradicted by the description, it also causes the independent claims to be interpretable to claim exactly the state of the art as represented by documents D1-D5 so that the independent claims lack novelty over any one of D1-D5.

It would have been necessary to delete that paragraph of page 10 lines 22-26  in order to clarify the independent claims and to reduce the degree of their anticipation by  any of the prior art documents D1-D5.

## 5. Lack of unity of invention a posteriori over D1
It is pointed out that the alleged inventive concept of claims 6 and 7, which focus on the filter table, lacks unity of invention a posteriori in the sense of Rule 13 PCT with the underlying main concept of the other dependent claims (which focus on the unrelated concept of claiming various ways of setting the number of samples to be used), because the subject-matter of independent claim 1, on which claims 2-11 depend, lacks novelty over D1 and therefore its features, which are common to claims 2-11 but not novel insofar as understood, do not contribute to any common inventive concept between claims 6 and 7, on one hand, and claims 2-5 and 8-11, on the other hand.